EXPRESS MAIL LABEL NO. EM607117875US

Attorney Docket No. 5903-157

TITLE OF THE INVENTION

Ordinary Hazard Extended Coverage Sidewall Sprinklers and Systems

BACKGROUND OF THE INVENTION

Applicants have demonstrated that it is possible to provide extended coverage ordinary hazard protection using ceiling sprinklers with extra large and larger orifices. Such sprinklers distribute water in a generally symmetrical circular pattern centered on the sprinkler. These sprinklers are disclosed in U.S. Patents 5,466,022, 5,664,630, 5,609,211 among others and these three patents are incorporated by reference herein.

Sidewall sprinklers are known which provide extended coverage but only for less demanding light hazard or residential applications. These applications require a sufficiently uniform delivery of water at an average density of 0.10 or less gallons per minute per square foot of area protected. Coverages greater than 100 square feet are considered extended coverages for sidewall sprinklers in ordinary hazard applications. In light hazard and residential applications, extended coverage is anything greater 196 square feet (16 x 16).

It is believed that the same advantages provided by extended coverage ordinary hazard ceiling sprinklers could be enjoyed in sidewall sprinkler applications if sufficiently uniform and effective water distribution can be demonstrated for a

sidewall sprinkler.

BRIEF SUMMARY OF THE INVENTION

An ordinary hazard extended coverage sidewall automatic fire sprinkler comprising a generally tubular body with a central passageway and a central axis, one end of the passageway forming an outlet at one end of the tubular body, a closure at the one end of the tubular body at least essentially generally closing the passageway, a trigger positioned to releasably retain the closure at the outlet closing the passageway, and a deflector at a discharge end of the sprinkler, the deflector being coupled with the tubular body facing and spaced axially away from the outlet and intersecting the central axis, the tubular body having a K factor greater than 9 and the deflector being shaped and positioned to transform water discharged horizontally from the outlet upon release of the closure by the trigger into a spray pattern of water droplets dispersed over a generally horizontal, generally rectangularly-shaped extended coverage area of at least two hundred and fifty-six square feet on one side of the sprinkler in an amount and with a distribution effective to control an ordinary hazard fire in the coverage area.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The foregoing summary, as well as the following detailed description of preferred embodiments of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the

invention, there is shown in the drawings embodiments which are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. In the drawings:

Fig. 1 is a partially broken, side elevation view of a first embodiment ordinary hazard sidewall sprinkler according to the present invention;

Fig. 2 is a side elevation, cross-section of the closure of the sprinkler of Fig. 1 taken along the lines 2-2 in Fig. 1;

Fig. 3 is a upright side elevational view of the deflector of the sprinkler of Fig. 1 without breakaway and without the sprinkler frame;

Fig. 4 is a top plan view of the deflector of Fig. 3;

Fig. 5 is a front elevational view of the deflector of Figs. 3 and 4 taken along the lines 5-5 of Fig. 3;

Fig. 6 is a plan view of a planar blank used to form the deflector of Figs. 3-5.

Fig. 7 is a partially broken, bottom view of a second embodiment ordinary hazard sidewall sprinkler according to the present invention;

Fig. 8 is an upright side elevational view of the deflector of the sprinkler of Fig. 7 taken along lines 8-8 in Fig. 7 without the sprinkler frame;

Fig. 9 is a top plan view of the deflector of Fig. 8;

Fig. 10 is a front elevational view of the deflector of Figs. 8 and 9 taken along the lines 10-10 of Fig. 8;

Fig. 11 is a plan view of a planar blank used to form the deflector of

Figs. 8 through 10;

Fig. 12 is a side elevational view of a typical installation of a sidewall sprinkler of the present invention and further illustrating mounting of sprinklers for water distribution testing;

Fig. 13 is a front elevational view of pairs of sidewall sprinklers of the present invention as typically mounted during installation and further illustrating their mounting for water distribution testing; and

Fig. 14 is a top plan view of Fig. 13.

DETAILED DESCRIPTION OF THE INVENTION

In the drawings, like numerals are used to indicate like elements throughout. There is shown in Fig. 1 a first preferred embodiment, extended coverage ordinary hazard sidewall sprinkler of the present invention indicated generally at 10. Sprinkler 10 includes a one-piece frame 11, a closure 30, a trigger 38 and deflector 40. Frame 11 includes a generally tubular body 12 and an adjoining yoke indicated generally 20. Body 12 defines a central passageway 13 having one open end defining an inlet 14 and an opposing open end defining an outlet 16 facing the yoke 20. The sprinkler body 12 may be conventionally provided with external threading indicated schematically by broken lines 15 around the inlet 14 to enable the inlet end to be screwed into a supply pipe (not depicted). Yoke 20 is preferably integrally and montilithically formed with the tubular body 12, for example, as a one-piece metal casting, and preferably comprises two mirror-

image arms 22 and 24, which extend away from the tubular body 12 on either side of a central axis A-A to a junction or "knuckle" 26. As can be seen from the figures, axis A-A represents a central axis of the inlet 14, outlet 16 and passageway 13 as well as of the tubular body 12 and the yoke 20. It is also a central axis for the water discharged through the outlet 16. Outlet 16 and yoke 20 define a discharge end indicated generally at 17 of the sprinkler 10.

A closure 30 is located at the outlet 16 closing the passageway 13. Closure 30 may or may be received in or over the passageway 13. Referring to Fig. 2, closure 30 is preferably an assembly which includes an asymmetrically shaped plug 32 having a circumferential, preferably right cylinder shaped groove 32a receiving an elastomeric washer or "O-ring" 34 preferably made of silicone. The "top" of the plug 32 extending from the groove 32a to a front face 32b, which is exposed at the outlet 16 of sprinkler 10, is symmetric and includes a circumferential flange or lip 32c forming a step between the groove 32a, and face 32b. The lip 32c is received in a matingly configured annular step 20a provided at the outlet 16 end of the tubular body passageway 13. A wave spring or "Belleville" washer 36 is provided around the body 32 and is sized to overlap the annular lip 32c to help bias the plug 32 from the outlet 16 when the closure 30 is released. Plug 32 further preferably includes a central bore 32d extending inward from the exposed face 32b and an asymmetrically shaped inner end 32e extending away from the groove 32a in a direction opposite the exposed face 32b. End 32e has a cupped surface 32f asymmetrically positioned with respect to a central axis

A-A of the sprinkler 10, which is also a central axis of the closure 30. Cupped surface 32f is provided to urge the plug 32 to tumble as the closure 30 leaves the outlet 16 of the tubular body 12 when sprinkler 10 is activated.

Trigger 38 is positioned between the closure 30 and the knuckle 26 of the yoke 20 to retain the closure 18 in the outlet 16 until the sprinkler is activated. Trigger 38 is preferably a thermally responsive, alcohol-filled glass bulb but may be any other suitable, thermally responsive, frangible or releasable device or other suitable, electrically operated release device capable of retaining the closure 30 in position at the outlet until activated by heat or remote control. Such release devices and elements are well known to those of ordinary skill in the art. The depicted trigger/bulb 28 is exemplary only but may, for example, have enlarged longitudinal ends, received in depression 32d, provided in the center of plug 32, and in a depression 28a provided in the tip of an adjustment or load screw 28 received in a threaded bore 26a passing through knuckle 26 along central axis A-A. Preferred bulbs have temperature ratings between about 155°F and about 200°F (with mean Response Time Indices ("RTI's") of between ? and ? meter$^{1/2}$ second$^{1/2}$?) in nominal sizes (widths) of 3 mm. See U.S. Patents 5,829,532 and 4,796,710, incorporated by reference herein. Such bulbs can be obtained from (Job GmbH of Germany ?).

Sprinkler 10 differs from other prior art, frame-type sidewall sprinklers in the configuration of its deflector 40 and in the size of its passageway 13 or "orifice". Sidewall sprinklers of the present invention use sprinkler bodies with

unusually large orifices having higher K factors. The "K factor" of a sprinkler is its discharge coefficient and determines the normal or average amount of water delivered through the passageway of the sprinkler as a function of water pressure supplied at the inlet. As used herein, the discharge coefficient or K factor of a sprinkler equals the flow of water in gallons per minute through the passageway of the sprinkler divided by the square root of the pressure of the water fed into the sprinkler inlet in pounds per square inch gauge. Underwriters Laboratories Inc.'s UL Standard 199 defines a "large orifice" sprinkler as one having a K factor of between 7.4 and 8.2 $\pm$ 5%. Sprinklers of the present invention use frames with larger than large orifices. In particular, sprinkler bodies of the present invention have K factors greater than 9, suggestedly between 10 and 14 and preferably between 11 and 12. The depicted frame 11 has a K-factor of 11.5. K-factors are indicated in nominal values but are permitted $\pm$ 5% variation.

The preferred body 12 of sprinkler 10 has a nominal height of about 1.05 inches. Passageway 13 has a maximum diameter at inlet 14 of about 0.77 and tapers down to a minimum diameter of about 0.63 near the outlet 16 before the central passageway 13 flares to form step 20a which accepts and supports the closure 30. The yoke 20 extends more than an inch from the widest part of the passageway 13 at the step 20a of outlet 16. The distance between the widest part of the passageway 13 and the facing surface of deflector 40 is about 1.25 inches.

Deflector 40 is supported from the frame 11 integrally secured with

the frame, by being mounted over a boss 26b provided at the extreme axial end of the knuckle 26 at the end of yoke 20. Deflector 40 is secured by suitable means such by swaging indicated generally at 27 or by a nut on a threaded end of the boss (neither depicted). Deflector 40 is shown in varying views in Figs. 3-5.

Deflector 40 includes a face portion 42, which is supported directly from the arms 22 and 24 through the boss 26b on knuckle 26 facing and spaced away from the outlet 16 of the frame body 12. Face portions of sidewall sprinklers of the present invention are at least generally or substantially planar. The preferred face portion 42 is at least essentially planar and is perpendicular to central axis A-A and vertical, when the sprinkler 10 is appropriately installed on a sidewall of a structure with its central axis A-A horizonal.

Deflector 40 further includes a canopy portion 44 extending generally horizontally over the face portion. Canopy portions of deflectors of the present invention are again at least substantially or generally planar and are supported from the face portions, oriented perpendicularly or nearly perpendicularly with respect to separate vertical planes parallel to the central axis A-A and to the face portion 42. As used herein when referring to an angular relation, the term "generally" means $\pm$ 10°. The preferred canopy portion 44 is at least essentially planar and is located adjoining but spaced radially outwardly away from and above an upper edge 42a of the face portion 42 and is supported by a pair of symmetric curved arms 52 and 54 of the deflector. Preferably, canopy portion 44 is oriented nearly horizontal when the sprinkler 10 is installed. As will be seen, in some embodiments it may be

necessary to pitch the canopy portion with respect to a true horizontal (bubble level) plane so that the far end 44a of the canopy portion 44 remote from the tubular body is tilted upwardly away from the central axis A-A and an imaginary horizontal plane along the central axis A-A to provide or permit some rise in discharged liquid.

A planar blank 40', which is bent to form deflector 40 of Figs. 1 and 3-5, is shown in Fig. 6. Features of the blank 40' which correspond to features in the final deflector 40 are indicated by the same reference numbers with primes. The elements of the deflector 40 and blank 40' are shown to accurate relative scale in the figures. That is while apparent size of deflector 40 may vary from figure to figure, at least with respect to Figs. 3-6, the relative dimensions and angles of the different portions of the deflector 40 (and blank 40') are accurate. For scale, the width of the canopy 44 is about 2 inches and its axial length over the central axis A-A is about 1.1 inches. Reference is also made to U.S. Patent No. 5,722,599, which is incorporated by reference herein in its entirety, for details regarding the construction and form of such sidewall deflectors as well as a description of their more detailed features.

Deflector 40 with frame 11 has been shown to be capable of controlling ordinary hazard fires over rectangular extended coverage areas of between 16 x 16 feet (256 square feet) and 16 x 20 (320 square feet) by being able to deliver a sufficiently uniform distribution of water over that area where such water is supplied to the sprinkler 10 at a pressure which causes the sprinkler to

discharge the water at a rate of at least 0.15 gallons per minute per square foot (GPM/ft.^{2}) of the coverage area to be protected and up to a rate of 10.20 GPM/ft.^{2}. In order words, water is supplied at a rate of at least 38.4 gallons per minute for a 16 x 16 foot coverage area to a rate of at least 48 gallons per minute for a 16 x 20 foot coverage area.

A second deflector 140 for a second preferred embodiment sprinkler 110, which is itself shown in Fig. 7 is shown in Figs. 8-10. The frame 11, closure 30 and trigger 38 of sprinkler 110 are identical to those of the first sprinkler 10. The blank 140' from which deflector 140 is formed is shown in Fig. 11. Again, the features of deflector 140 and its blank 140' are substantially to relative scale with the face portion 142 of the deflector 140 being approximately 1.5 inches wide and the canopy portion 144 being of the same width and about 1.1 inches in length. Sprinkler 110 can control ordinary hazard fires in a 16 foot x 22 foot to 16 foot x 24 foot coverage area when pressurized to supply water at a rate of at least 0.15 gallons per minute and up to 0.20 GPM for each square foot of such extended coverage area.

Both deflectors 40 and 140 are preferably made from a conventional metallic material such as 90/10 bronze (alloy 220 sheet), approximately 40 mm thick with an RB hardness of 60-70. Blanks are stamped flat from such sheets and bent to final form.

Note that in the second embodiment sprinkler 110, the frame arms 22, 24 are preferably located on either side of central axis A-A to lie in a horizonal plane

through central axis A-A generally parallel to the canopy portion 144 of deflector 140. The arms 22, 24 of the first sprinkler embodiment 10 preferably are positioned above and below central axis A-A and lie in a vertical plane through central axis A-A and generally perpendicular to canopy portion 44.

Figs. 12-14 depicts diagrammatically a sidewall sprinkler system utilizing at least a pair of the preferred embodiment, frame-type, ordinary hazard extended coverage sidewall sprinklers 10 and/or 110 of the present invention. Sprinklers 10 and 110 are installed in conformance with national fire sprinkler system installation standards (NFPA Standard 13). Deflectors should be located not less than four inches and not more than six inches from the nearest adjoining wall and ceiling unless special exceptions apply. In particular, each sprinkler 10 or 110 is typically mounted protruding from a flat vertical wall 80 extending between a parallel ceiling 82 and floor 84 by means of a stem 86 branching from a common supply pipe 88 supplying water to other sprinklers of the system. Each sprinkler 10 or 110 is positioned so as to protect a coverage area F within a structure within which the sprinkler 10,110 is installed. Area F is located immediately below and forward of the discharge end 17, 117 of the sprinkler(s) 10, 110. Area F is at least generally rectangular and even may be square (e.g.,16 feet x 16 feet) and has a length L extending in axial direction away from the outlet 16 and discharge end 17 and a width W perpendicular to the length L. Sprinklers of the present invention provide a generally horizontal spray pattern of water droplets such that each sprinkler effectively covers at least generally rectangular (as opposed to circular)

area of 256 or more square feet in size and is effective in controlling ordinary hazard fires in such area. More particularly, sprinkler 10 of the present invention provides a desired uniform distribution of water in coverage areas of between 16 x 16 square feet and 16 x 20 square feet, both inclusive, while sprinkler 110 provides such a distribution in coverage areas of between 16 x 22 square feet and 16 x 24 square feet both inclusive when either sprinkler 10, 110 is pressurized to deliver to those areas average water densities of between 0.15 and 0.20 gallons per minute per square foot (GPM/ft^2). When an identical pair of sprinklers 10 or 110 of the present invention is installed as indicated in Figs. 12 through 14 and pressurized as indicated above, they will provide a distribution of water droplets found effective to control ordinary hazard fires in the coverage area F extending away from their discharge end.

For water distribution testing, pairs of the sprinklers 10, 110 are installed at their rated lateral spacing (e.g. 16 feet on center) with the deflector canopy 4 1/2 inches from the lower surface of the ceiling 82 and with the defector face 6 inches from the proximal outer surface of the adjoining vertical wall 80. A collection area A is defined beneath and between the two sprinklers at either of two heights: a height of 6 feet 7 1/2 inches below canopy portion 44 or 144 and 36 inches below the canopy portion 44 or 144 of each sprinter 10, 110. See Underwriter's Laboratories, Inc. current UL Standard 199, incorporated by reference herein in its entirety for details of the water distribution test set-up and distribution criteria as well as the fire test (crib) set-up and criteria. It is possible to effectively

control ordinary hazard fires without fully complying with the water distribution test criteria but it is believed that a sprinkler which can meet that criteria will, without question, be able to control ordinary hazard fires.

While preferred embodiments of the invention have been described and some possible changes thereto noted, it be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed, but it is intended to cover all modifications within the spirit and scope of the present invention as defined by the appended claims.

CLAIMS

1. An extended coverage to a sidewall automatic fire sprinkler comprising a generally tubular body with a central passageway and a central axis, one end of the passageway forming an outlet at one end of the tubular body, a closure at the one end of the tubular body at least essentially generally closing the passageway, a trigger positioned to releasably retain the closure at the outlet closing the passageway, and a deflector at a discharge end of the sprinkler, the deflector being coupled with the tubular body facing and spaced axially away from the outlet and intersecting the central axis, the tubular body having a K factor greater than 9 and the deflector being shaped and positioned to transform water discharged horizontally from the outlet upon release of the closure by the trigger into a spray pattern of water droplets dispersed over a generally horizontal, generally rectangularly-shaped extended coverage area of at least two hundred and fifty-six square feet on one side of the sprinkler in an amount and with a distribution effective to control an ordinary hazard fire in the coverage area.

2. The sprinkler of claim 1, wherein the tubular body has a K factor of between 10 and 13, both inclusive.

3. The sprinkler of claim 2, wherein the K factor is between 11 and 12, both inclusive.

4. The sprinkler of claim 1, wherein the trigger is a liquid-filled glass bulb.

5. The sprinkler of claim 1, wherein the at least generally rectangularly shaped coverage area receiving water from said sidewall sprinkler is

up to at least two hundred and eighty-four square feet in size.

6. The sprinkler of claim 5, wherein the at least generally rectangularly shaped coverage area receiving water from said sidewall sprinkler is up to at least three hundred and twenty square feet in size.

7. The sprinkler of claim 1, wherein the at least generally rectangularly shaped coverage area is more than three hundred and twenty square feet in area.

8. The sprinkler of claim 7, wherein the at least generally rectangularly shaped coverage area is at least up three hundred and eighty-four square feet in size.

9. The sprinkler of claim 1, wherein the coverage area is at least sixteen feet by sixteen feet square.

10. The sprinkler of claim 9, wherein the coverage area is up to at least sixteen feet by eighteen feet in size.

11. The sprinkler of claim 10, wherein the coverage area is up to sixteen feet by twenty feet in size.

12. The sprinkler of claim 1, wherein the coverage area is sixteen feet by at least twenty feet in size.

13. The sprinkler of claim 12, wherein the coverage area is sixteen feet up to twenty-four feet in size.

14. The sprinkler of claim 1, wherein the deflector comprises an at least generally planar face portion positioned facing and spaced axially away from the outlet along the central axis so as to at least perpendicularly intersect the column of water issuing from the outlet along the central axis and a canopy portion supported on one side of the face portion spanning the face portion, the canopy portion being generally parallel with the central axis and perpendicular to the face portion, the deflector being configured to deliver water to the coverage area in a density of at least ___ gallons per minute/ft^2 to achieve a generally planar spray

pattern of water droplets generally parallel to a major side of the canopy portion facing the central axis, the spray pattern extending at least sixteen feet beyond the face portion and at least eight feet to either lateral side of the central axis when the sprinkler is positioned with the central axis horizonal and the major side of the canopy portion facing the central longitudinal axis generally horizonal and above the central longitudinal axis whereby said ceiling sprinkler is effective in controlling ordinary hazard fires over a coverage area of at least sixteen feet by sixteen feet when pressurized to supply water at a rate of between 0.15 and 0.20 gallons per minute/ft^2 times the size of the coverage area in square feet.

15. The sprinkler of claim 14, wherein the coverage area is at least three hundred and twenty square feet.

16. The sprinkler of claim 14, wherein the coverage area is at least three hundred and eighty-four square feet.

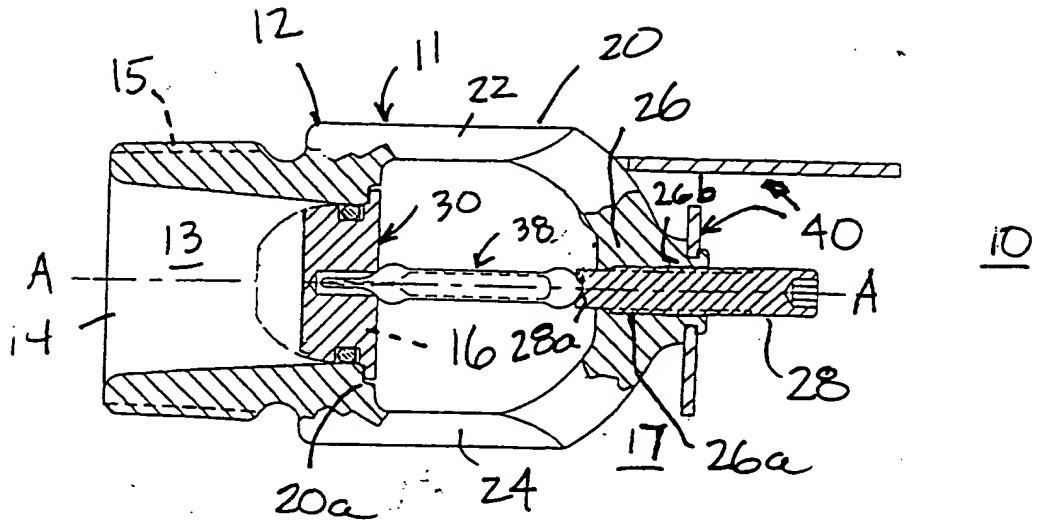
17. The sprinkler of claim 1 wherein when paired with an identical extended coverage sprinkler the deflectors of the identical pair of the sidewall sprinklers being configured such that when the pair of identical sprinklers are identically arranged side by side spaced with central axes parallel and horizontally coplanar and at least sixteen feet apart at or within two feet of a generally smooth ceiling parallel to the central axes and at least coextensive in size with a collection area between the pair of sprinklers, the collection area and the ceiling being as wide as the spacing between the central axes and at least sixteen feet long, and water is supplied simultaneously to each of the pair of sprinklers at a common pressure sufficient to flow through each sprinkler at a discharge rate equal to the collection area between the sprinklers in square feet times a discharge density of 0.15 GPM/ft^2, the water is actually delivered by the pair of sprinklers to the collection area between the pair of sprinklers at a height no more than six feet seven and one-half inches beneath the canopy portions of the deflectors at an average density of ____ GPM/ft^2, that two-foot square portions of the collection area entirely across the

collection area receive water at an average density of at least GPM/ft^2 and that each square foot of the collection area receives water at a rate of at least 0.02 GPM.

18. The sprinkler of claim 17 in which the pair of identical sprinklers deliver water at a density of at least 0.03 GPM to each square foot of the collection area, when the four sprinklers are supplied with water at the selected discharge density.

19. The sprinkler of claim 17 wherein the area collection is located only three feet beneath the canopy portions of the pair of sprinklers.

ABSTRACT OF THE DISCLOSURE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11
20
15
22
26
26b
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38
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10
13
A
A
14
16
28a
28
17
26a
20a
24

FIG. 1

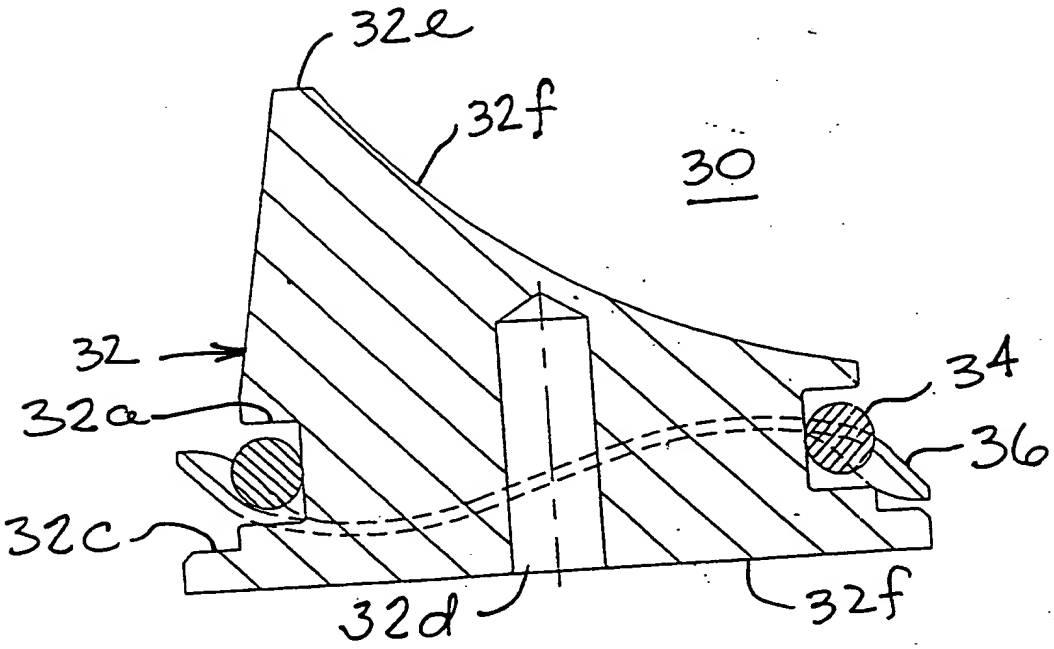
32e
32f
30
32
34
32a
36
32c
32d
32f

FIG. 2

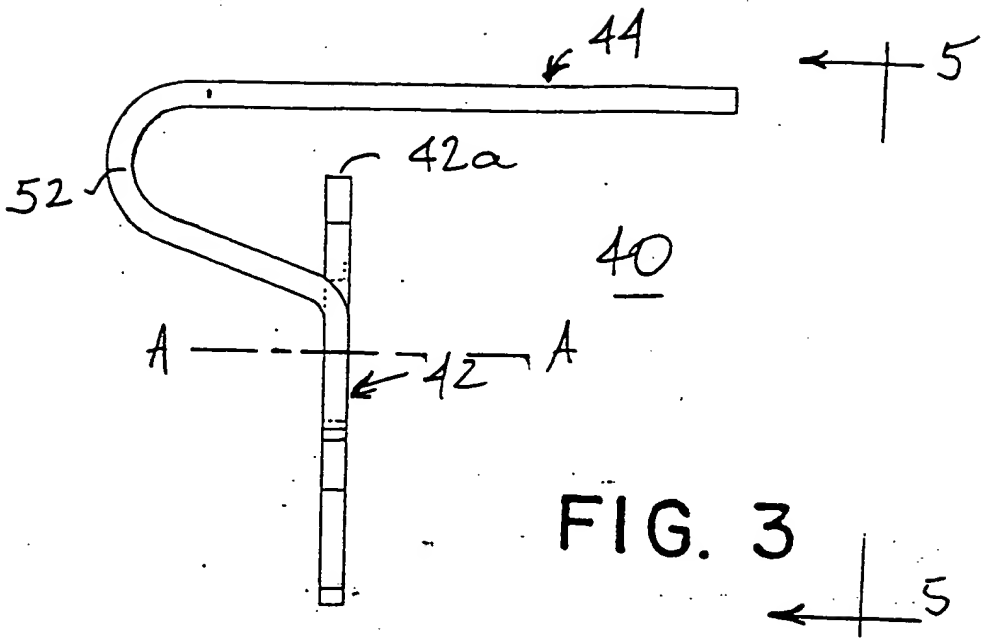

FIG. 3

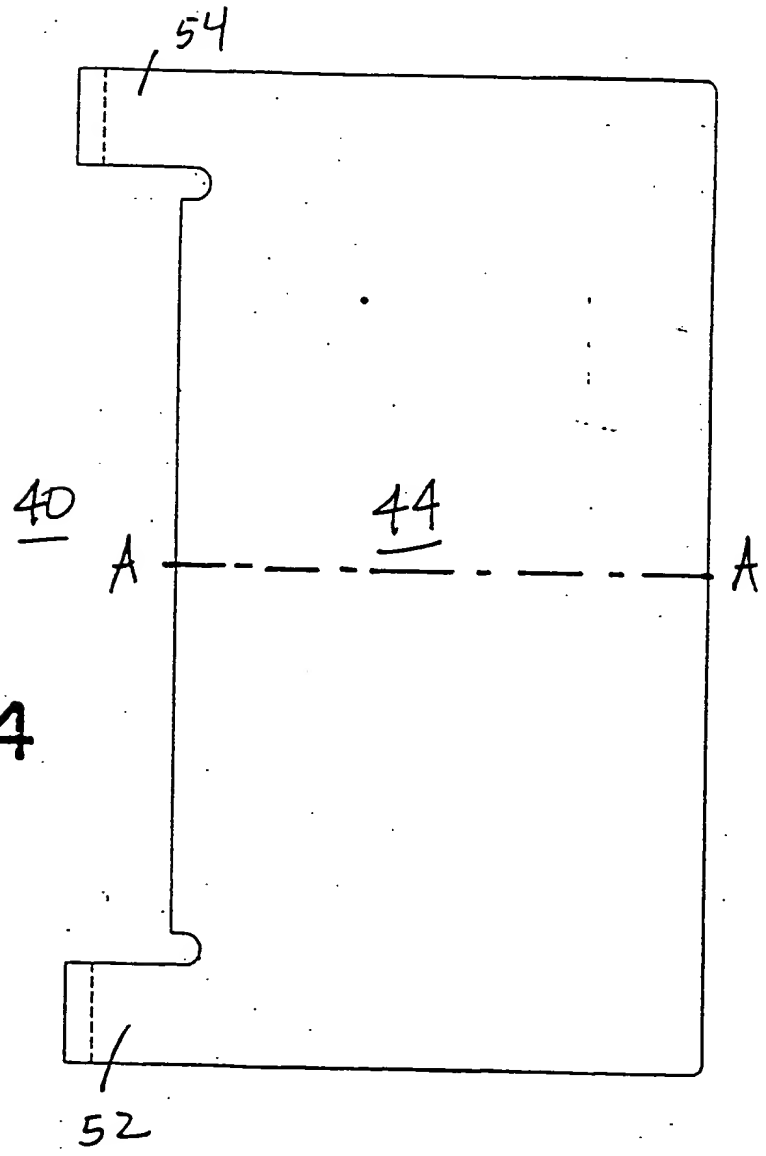

FIG. 4

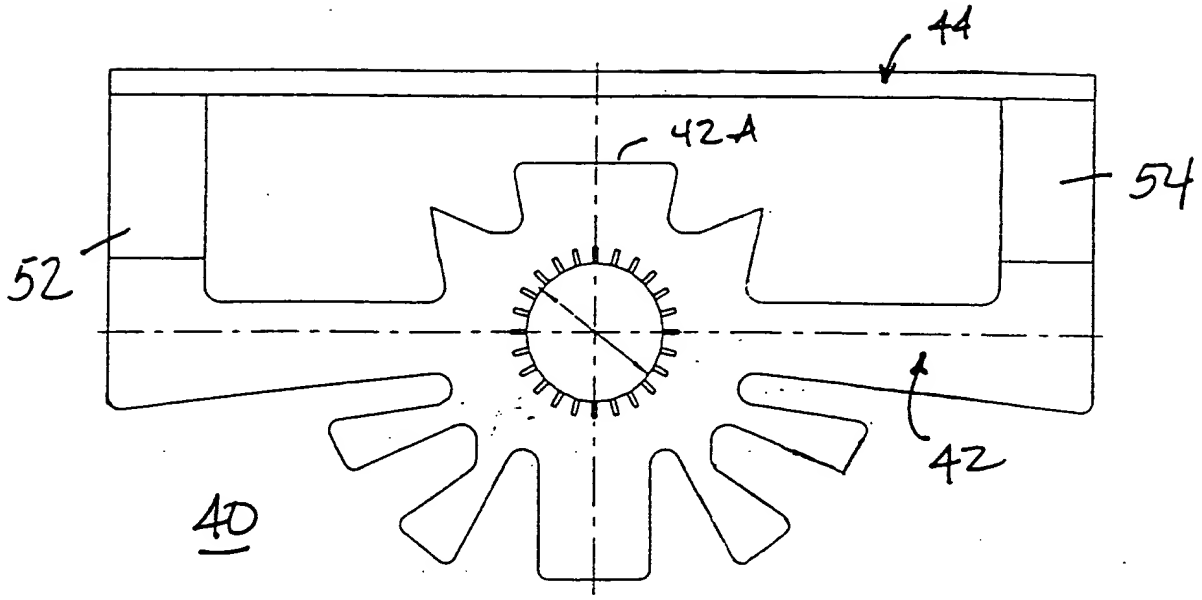

FIG. 5

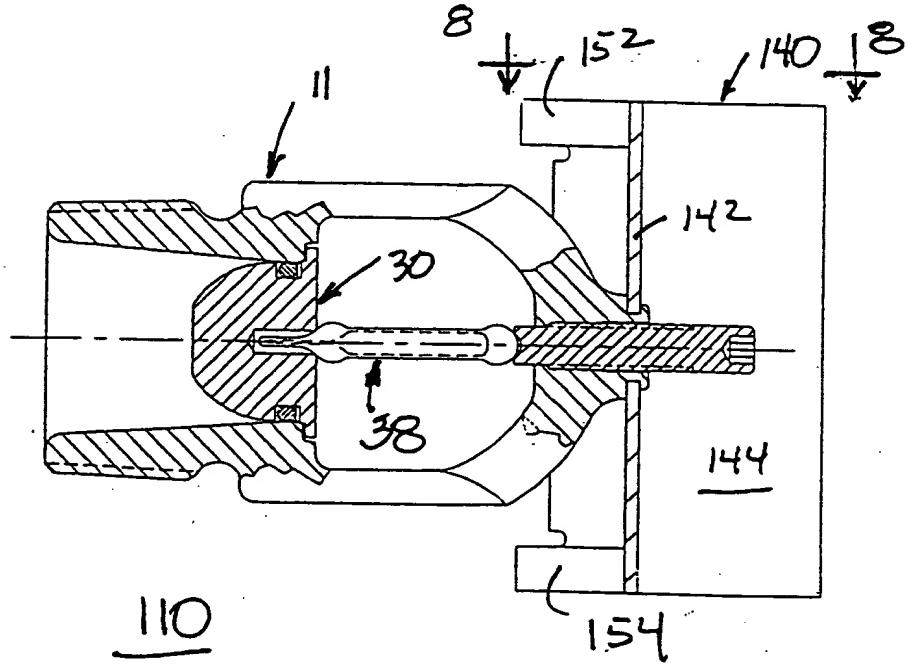

FIG. 7

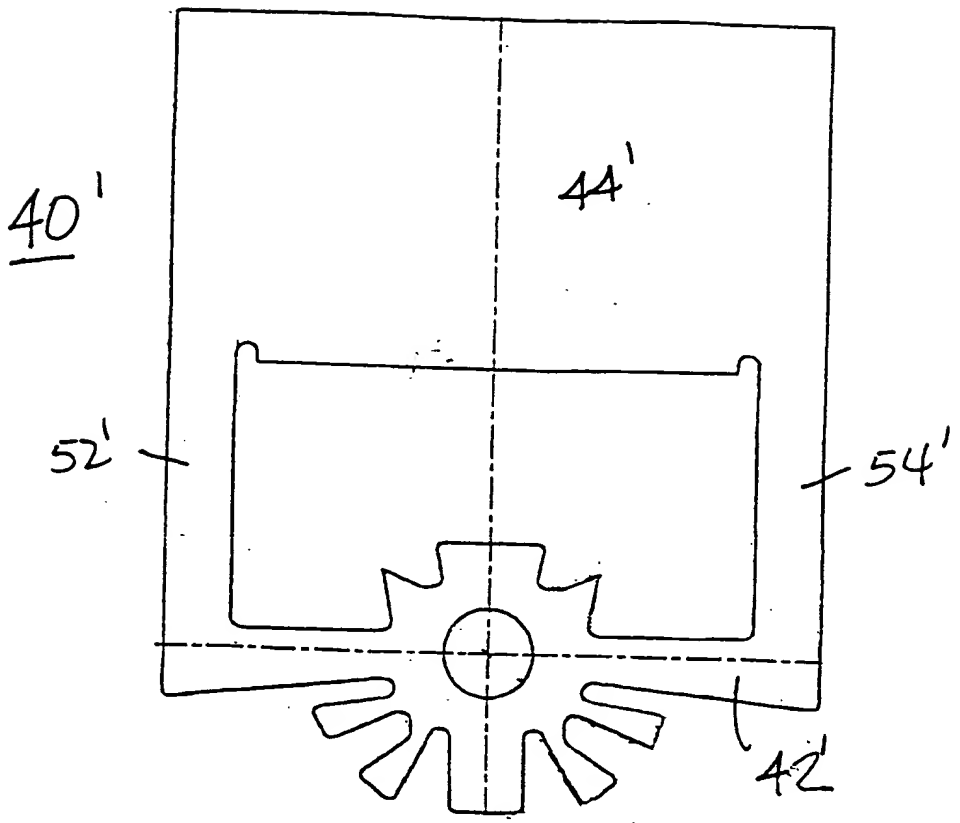

FIG. 6

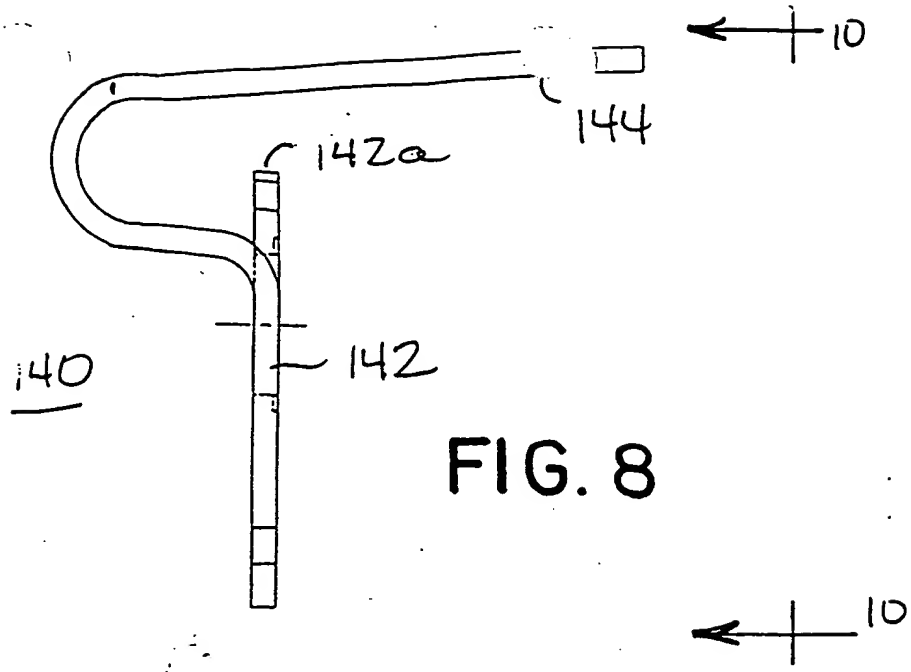

FIG. 8

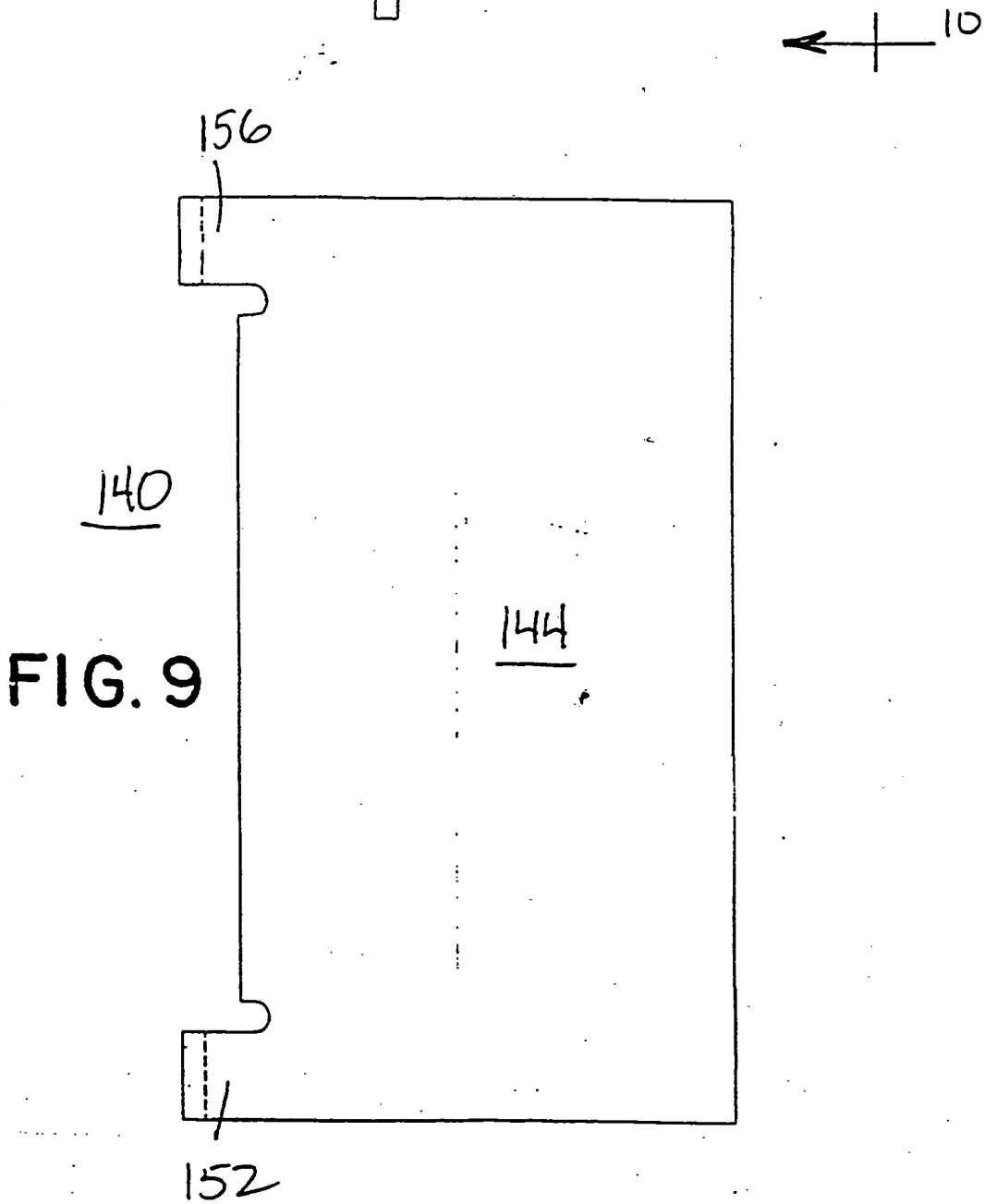

FIG. 9

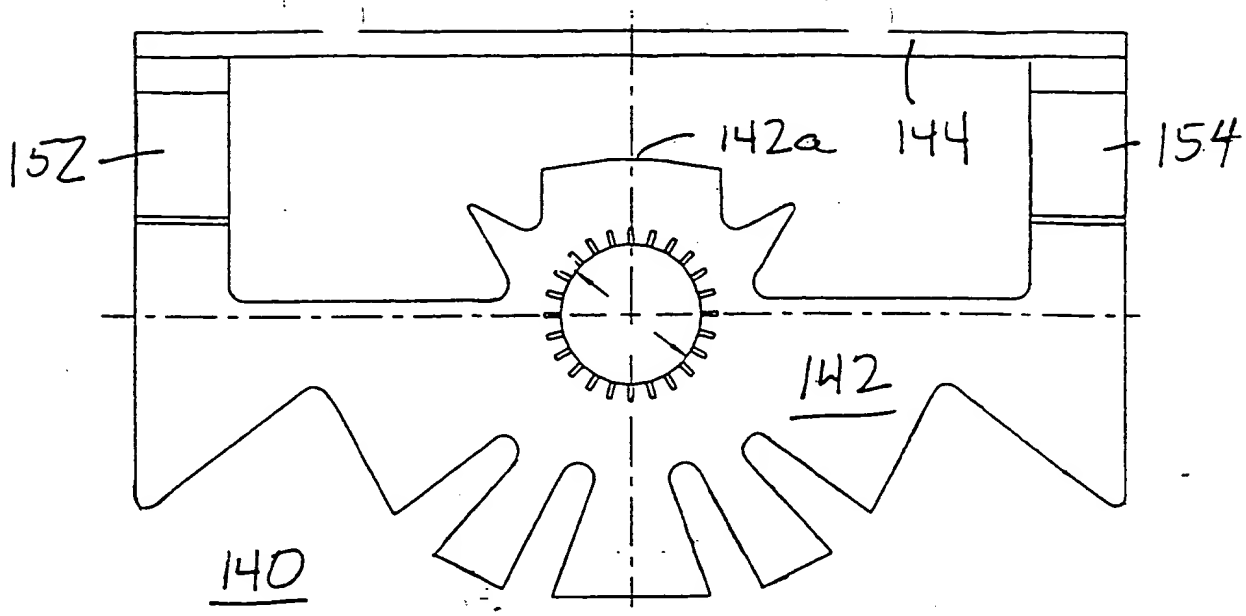

FIG. 10

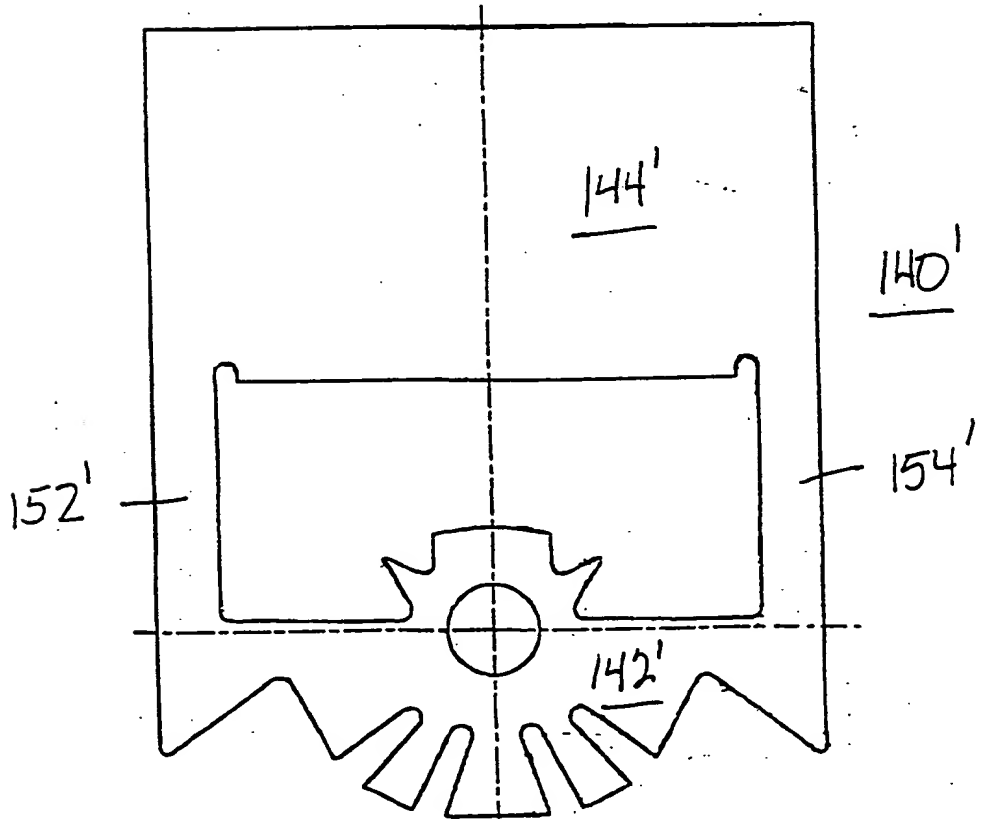

FIG. 11

ELO HSW ECOH SPRINKLER H_2 DISTRIBUTION

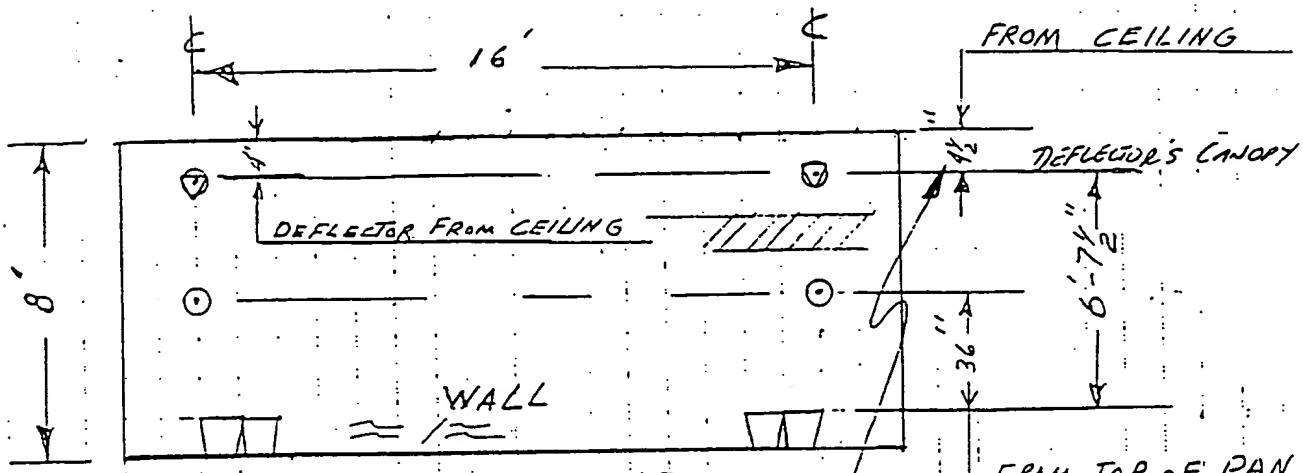

Fig. 13

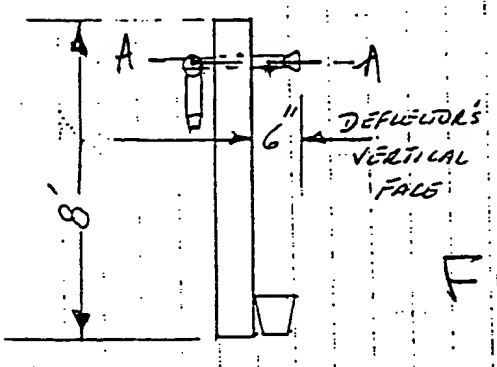

Fig. 12

DUE TO UL's CEILING WARPAGE

Fig. 14